What happened to Tasmania's Stubble Quail?

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Summary. In the early 20th century, Stubble Quail *Coturnix pectoralis* were common in Tasmania, more so than the Brown Quail *C. ypsilophora*. By the mid 20th century, the Stubble Quail had almost disappeared and was granted full protection, although this decline largely has been forgotten. It is possible that Stubble Quail became extinct in Tasmania, and the rare sightings now are of stragglers from either the Australian mainland or King Island. There have been recent observations around Cressy, in northern Tasmania, that may be of a resident population. The decline of the Stubble Quail has been overlooked by current workers and has clouded its conservation status. It may deserve listing as an endangered species in Tasmania.

Introduction

The Stubble Quail *Coturnix pectoralis* has been said to once have been abundant on the mainland of Tasmania (Blakers *et al.* 1984). That assessment contrasts with its current status; it is now considered rare and seen only occasionally in the north of the state and on the Bass Strait Islands (Marchant & Higgins 1993; Barrett *et al.* 2003). If this change in status is real, the Stubble Quail in Tasmania must have suffered a catastrophic decline, probably equal to that of the Swift Parrot *Lathamus discolor* and Orange-bellied Parrot *Neophema chrysogaster* (e.g. Garnett *et al.* 2011). However, it is not currently listed as threatened under state or national threatened species legislation.

It is possible that this apparent change in abundance was based on misidentified Brown Quail *C. ypsilophora*. However, if the decline is real, then the question arises as to why this has occurred, especially as Stubble Quail have adapted well to agricultural activities on the Australian mainland and are still abundant there (Marchant & Higgins 1993).

The purpose of this paper is to review the evidence that the Stubble Quail was once abundant in Tasmania, and to suggest reasons why it continues to thrive on the Australian mainland but suffered such a dramatic decline in Tasmania. Stubble Quail have sometimes been considered conspecific with the New Zealand Quail *C. novaezelandiae*, which became extinct in the 19th century. Thus, the history of extinction of the New Zealand Quail (reviewed by Gill 1991 and Marchant & Higgins 1993) might shed light on the decline of Stubble Quail in Tasmania.

John Gould on Stubble Quail

Gould described and named the Stubble Quail in his *Synopsis* in 1837, before his trip to Australia, based on a bird collected in New South Wales (NSW) (Gould

1837). His *Synopsis* contains no further information beyond a plate of the head of a male Stubble Quail. Gould (1846) stated that 'in Van Diemen's Land [= Tasmania], South Australia and New South Wales the [Stubble Quail] is very abundant'. The reliability of Gould's statement about the abundance of Stubble Quail, therefore, may depend on whether it was based on his personal experience or on reports by correspondents who might be less dependable than Gould himself.

Gould arrived in Australia in September 1838 and stayed for 19 months, about seven of these in Tasmania (Sauer 1981). Although he did most of his Tasmanian collecting in southern Tasmania, he also made two trips to the north of the island. In late December 1838 and early January 1839, he travelled overland from Hobart to Launceston and Georgetown, for the purpose of visiting the Bass Strait islands. He visited Isabella, Green, Flinders and Waterhouse Islands (Sauer 1981). On 11 May 1839, he travelled from Hobart to Launceston again, departing for South Australia on 18 May (Tree 1991). Although he made collections in the Bass Strait islands, he spent only limited time collecting in northern Tasmania or the Midlands, mainly while travelling from Hobart to Launceston (Sauer 1981). He returned in August to Hobart, where he spent another 2 weeks around Hobart, before departing for NSW on 20 August 1839 (Sauer 1981).

Gould's writings provide evidence that he had personal experience of Stubble Quail in the field, though not necessarily in Tasmania. He stated that 'I sometimes flushed a single bird without finding another in the neighbourhood, while at others I met with it in pairs or in small parties of from four to six in number' (Gould 1846). As he had originally described the Stubble Quail in 1837, and pictured Brown Quail on the plate immediately before the Stubble Quail description (Gould 1837), he was already familiar with both species. Gould (1865, p. 191) also described the eggs of the Stubble Quail, stating 'I frequently found its nest and eggs; they have a strong resemblance to those of our own [Common] Quail [*Coturnix coturnix*]; but much variation exists in their colouring, some being largely blotched all over with brown on a straw-white ground, while from this to a finely spotted marking every variety occurs'. He correctly described Stubble Quail eggs as being often blotched, unlike those of the Brown Quail which are usually covered in fine speckling.

Another suggestion that Gould found the Stubble Quail common in Tasmania is that he was confident enough to characterise its breeding season: he stated that 'September and the three following months constitute the breeding season; but it is somewhat later in Tasmania than in South Australia and New South Wales' (Gould 1865, p. 191). Gould (1865, p. 191) said that 'the name of Stubble Quail has been given to it by the colonists of Tasmania, from the great numbers that visit the fields after the harvest is over'.

There are two Stubble Quail specimens collected in Tasmania that previously belonged to Gould, an adult male and female (see Appendix 1 for specimen details). These are in the Academy of Natural Sciences (now Drexel University Academy of Natural Sciences) in Philadelphia, USA. However, there are no surviving labels to say whether they were collected by Gould, John Gilbert (Gould's collector on his Australian expedition) or someone else (C.T. Fisher pers. comm.).

Unfortunately, Gould's accounts are not conclusive proof of the status of the Stubble Quail in Tasmania, because he was known to use the accounts of others in his publications but, in the case of Stubble Quail, he described their abundance only in the areas he is known to have visited himself. Gould had also been sent specimens from Western Australia and one example from the 'north coast', probably by Gilbert, but he did not speculate on their abundance in these areas. Later accounts that give more definitive information support Gould's views.

The Stubble Quail in Tasmania after 1840

Other specimens of the Stubble Quail held in museums give some evidence to support the idea that this species was once more common in Tasmania than at present (see Appendix 1 for specimen details). The Natural History Museum (UK) holds just over 30, of which two are 19th-century Tasmanian skins (R. Prŷs-Jones pers. comm.). These were collected in the 1830s and in 1840, and are therefore contemporaneous with Gould's collection. In addition to the two Gould specimens, the Academy of Natural Sciences also holds one Tasmanian specimen that was collected in 1885 'near Hobart'. The Australian Museum holds five clutches of Stubble Quail eggs, all of which were collected in southern Tasmania. Museum Victoria holds three specimens from Tasmania: two from the late 19th and early 20th centuries, and one for which there appears to be no information except that it was collected in Tasmania. The South Australian Museum holds four Tasmanian specimens, all of which are from northern Tasmania and all of which date to the first decade of the 20th century. One specimen held in the Australian National Wildlife Collection is from Tasmania and was collected on Flinders Island in 1966.

Three Tasmanian specimens of Stubble Quail, which are dated before 1940, are held in the Tasmanian Museum and Art Gallery. All were collected in southern Tasmania. The Queen Victoria Museum in Launceston holds two specimens which were collected in Tasmania. One is an egg collected in Cleveland in northern Tasmania in 1930, and the other is an adult female collected on Flinders Island in 1966. In addition, the Tasmanian Museum and Art Gallery holds five and the Queen Victoria Museum holds six specimens for which there appear to be no dates or collection information (see Appendix 1).

Only four of the Tasmanian specimens held in Australian museums are known to come from the period post-1940, and two of these are from Flinders Island. Two were collected in Clarence, a suburb of Hobart, but these are probably birds that Cruise (1966) used in a behavioural study of captive birds.

The Allport Library and Museum of Fine Arts in Hobart (Tasmanian Archive and Heritage Office) contains a collection of images (albums) donated by the Allport family. Two of the images in the collection are made for viewing in equipment to make them appear three-dimensional, and are titled 'A shooter's bag of several quail' and 'Shooter's bag – a brace of wattlebirds and several quail'; they depict Stubble Quail (Figures 1 and 2). These images are dated 1860–1870 and are attributed to Morton Allport (born 1830, died 1879), but there are no records indicating where the images were taken. The first image merely depicts several Stubble Quail (Figure 1), but the second (Figure 2) clearly demonstrates that the

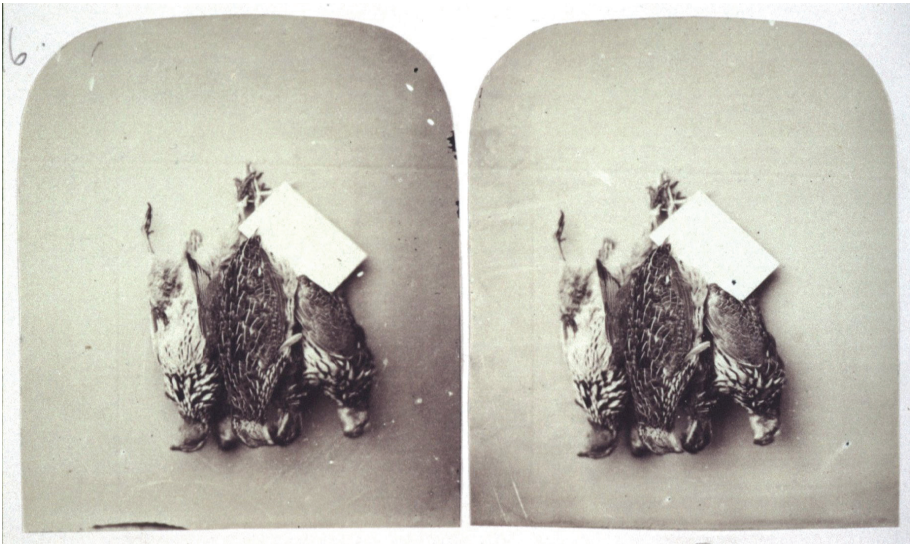

Figure 1. A shooter's bag of several quail, M. Allport (1860–1870). Allport Library and Museum of Fine Arts, Tasmanian Archive and Heritage Office.

Figure 2. Shooter's bag – a brace of wattlebirds and several quail, M. Allport (1860–1870). Allport Library and Museum of Fine Arts, Tasmanian Archive and Heritage Office.

'bag' was taken in Tasmania, because the wattlebirds are identifiable as Yellow Wattlebirds *Anthochaera paradoxa*, a Tasmanian endemic species. Clearly, sportsmen were shooting Stubble Quail in Tasmania in the mid 19th century, along with other species such as wattlebirds and Spotted Quail-thrush *Cinclosoma punctatum*.

After Gould, the next published reference directly referring to Stubble Quail observations in Tasmania is Littler (1903, p. 170) who, in the Launceston area, stated that 'stubble quail (*Coturnix pectoralis*) [are] comparatively plentiful in some parts... [while] brown quail (*Synoecus australis*) [are] not as plentiful as the preceding species'. In the Wilmot area (north-western Tasmania), Fletcher (1903, pp. 109–110) stated that

> Amongst the grain fields the Stubble Quail (*Coturnix pectoralis*) is always to be found. It is a pity such numbers of their eggs are destroyed during harvesting operations. During February there are lots of nests containing eggs to be found, and the latest date in the year I have observed their eggs was about 16th April. The bird was sitting on seven eggs, which appeared [to be] within a few days of being hatched.

She clearly distinguished between Stubble and Brown Quail, observing that:

> On the flats near the River Forth and in swampy situations near the creeks the Brown or Swamp Quail (*Synoecus australis*) is always to be flushed; it rises suddenly, and flies quickly away. It often makes its nest under a rush clump.

Later, Littler (1910, p. 106), in his *Handbook,* stated for Stubble Quail that:

> Practically every district that has been cultivated holds [Stubble Quail]... in greater or lesser numbers. Areas that have been down with cereal crops are preferred to mere grassland as they provide a far better supply of food...

Littler (1910) distinguished between Stubble and Brown Quail. The description reads like that of an author working from preserved specimens. It appears that at least some of Littler's specimens were sent to the South Australian Museum (see Appendix 1).

North (1913) reported that a clutch of eggs was collected by Malcolm Harrison at Glenorchy on the Derwent River (this clutch is now held in the Australian Museum; see Appendix 1), in an area where Stubble Quail have not been reported for over a century.

Cayley (1931) stated that the distribution of the Stubble Quail was Australia (except the tropical coastal districts) and Tasmania. Unlike the authors of later field guides, he did not qualify this statement by saying that this species was rare in Tasmania.

Mattingley (1938, p. 10), who was part of an expedition to the Hogan Island group in Bass Strait, also reported the presence of Stubble Quail, saying that 'from the dry grass a pair of Stubble Quail (*Coturnix pectoralis*) winged their way'. Even later authors, who did not consider the Stubble Quail a member of the avifauna of Tasmania proper, still considered that it was common or at least normally present on various Bass Strait islands.

A catastrophic decline of Stubble Quail in Tasmania after 1940?

Dickison (1951, p. 266), in reviewing the first 50 years of the Royal Australasian Ornithologists Union (RAOU), reported that 'through the efforts of the Union the Tasmanian Fauna Board extended full protection to the Wedge-tailed Eagle [*Aquila audax*] and Stubble Quail in Tasmania (in 1944–45)'. This change in protection indicated that there already must have been some concern for this species.

Sharland (1953, p. 316), reporting as the spokesman for the RAOU in Tasmania, stated that by 1953 'the Stubble Quail has almost disappeared'. Later, Sharland (1958, p. 5) stated that the 'Stubble Quail [is] very rare [but was] once fairly common' and that 'the Stubble Quail has almost disappeared from Tasmania during the last ten or twelve years'. Essentially from this date on, there was increasing concern expressed for the species in that state, with many observers noting its absence or rarity in mainland Tasmania, with pockets still surviving on the Bass Strait Islands (Condon 1975; Green 1977; Sharland 1981; Watts 2002). Indeed, some observers failed to include Tasmania as part of the distribution of the species (Slater 1970; Reader's Digest 1976, 1988), although a distribution map in the latest assessment (Hall 2013) shows an occupied area in the central north (presumably centred on the Cressy population; see p. 30).

Green (1977) stated that Stubble Quail were uncommon and sedentary in Tasmania and on Flinders Island, but common on King Island. He later mentioned that a reduction in grain-growing has been suggested as one explanation for its numbers having 'drastically declined during the first half of the twentieth century' (Green 1995, p. 35).

Thomas (1979), working from published records, provided a historical assessment of the distribution of the Stubble Quail in Tasmania. He included the Stubble Quail (as *Coturnix novaezelandiae*) in a list of birds recorded in fewer than 10 grid squares over the period 1900–1976, and did not provide a distribution map for the species.

Blakers *et al.* (1984, p. 115) presented perhaps the most comprehensive and objective assessment of the distribution and abundance of the Stubble Quail, as well as reviewing the historical literature. They stated that:

> it was common last century in Tas. and, even in 1910, was considered an important game species throughout the State's agricultural areas. Between 1940 and 1960 it disappeared almost entirely from Tas. So complete and quick was its demise that some comprehensive reviews ... overlook its former abundance. All but two Field Atlas records from the Tas. Region were from King I. (39/144).

The views expressed by Blakers *et al.* (1984) may have influenced subsequent authors. Cayley (1984, p. 511) described the distribution of Stubble Quail as including 'Tasmania [where it is]... erratic and highly local'. The second edition of Reader's Digest (1988, p. 163) had amended the distribution information for Stubble Quail to state that it was 'formerly found in Tasmania, [but is] now extinct there'.

Green & McGarvie (1971) surveyed the birds of King Island and found that Stubble Quail were common in areas of crop and grassland. They indicated that a specimen collected there was held in the Queen Victoria Museum (Launceston), but it is now impossible to identify this specimen from the information in the Museum's database (C. Reid pers. comm.).

Graham Hall (pers. comm.), a Senior Game Management Officer and an authority on quail in Tasmania, stated that between 1997 and 2003 he had never seen Stubble Quail on King Island and rarely saw Brown Quail there either, despite the assertions of most authors that King Island is the stronghold of the former in Tasmania. There is, however, a small population of Stubble Quail established on a farm near Cressy, south of Launceston (G. Hall pers. comm., and mapped in Hall 2013). This population appears to be resident, having persisted over time, but it is of recent advent. The experience of the landowner suggests that it became established sometime within the past 15 years.

The apparent acceptance of the Stubble Quail's previous abundance on mainland Tasmania is not universal. Some Tasmanian wildlife officers (pers. comm.) were unaware that Stubble Quail may have once been common in Tasmania, and dismissed previous reports as having probably been based on misidentification. G. Hall (pers. comm.) also believes that some recent reports of Stubble Quail in Tasmania are based on misidentified Brown Quail. For example, although hunters claim that they are seeing Stubble Quail, Hall has challenged them to produce a specimen but is yet to see one. However, given that Stubble Quail are not a permitted game species in Tasmania, the reluctance of hunters to reveal shot birds may be related to fear of prosecution rather than an absence of birds.

Bill Wakefield (pers. comm.), like Graham Hall, had compiled many reports from hunters of Stubble Quail from northern Tasmania, including Woolnorth. He believed that hunters' identifications are reliable and that records from bird observers under-record the presence and abundance of quail. Olsen *et al.* (1993, p. 128) similarly concluded that 'quails are difficult to observe, most birdwatchers are poor quail watchers'. Stubble Quail may also be reported only in the north of the state, because hunting of Brown Quail is only permitted in the north.

Despite the absence of systematic surveys, the three bird atlases (Thomas 1979; Blakers *et al.* 1984; Barrett *et al.* 2003) present a very consistent picture. The reporting rate for Stubble Quail, taking into account both areas in which hunting is permitted and those where it is not, is very much lower than for the equally inconspicuous Brown Quail. Furthermore, the period between the two RAOU/Birds Australia Atlases (Blakers *et al.* 1984; Barrett *et al.* 2003) appears to demonstrate a continuing decline in the reporting of Stubble Quail sightings relative to the reporting of Brown Quail.

The only site indicated in the *New Atlas of Australian Birds* (Barrett *et al.* 2003) appears to correspond with the Cressy population (also Hall 2013), a possible observer bias at a known Stubble Quail site. Hall's observations support evidence in the *New Atlas* of the current presence and abundance of Stubble Quail in Tasmania. The *New Atlas* shows an absence of records from King Island, which has been known as the stronghold of Stubble Quail in Tasmania, and the data also

indicate a decline in Brown Quail sightings on King Island (but not elsewhere in the state). Graham Hall (pers. comm.) also reported that the abundance of the introduced California Quail *Callipepla californica* has declined along with the other species. A likely interpretation of the present rarity of sightings of Stubble Quail on King Island is that they have declined there, but because this decline has also affected Brown Quail and California Quail it may not be attributable to the same cause as that which affected Stubble Quail in the rest of Tasmania over 50 years earlier.

Were Stubble Quail year-round residents in Tasmania?

No Tasmanian authors appear to have remarked on any large-scale movement of Stubble Quail into and/or out of Tasmania. Green (1977) went so far as to describe them as sedentary. In view of Littler's (1910) statement that, in Tasmania, Stubble Quail are to some extent nomadic, moving between different habitats within and between districts with the changing availability of food, it is probably more appropriate to consider them resident but locally nomadic.

North (1913) stated that in coastal eastern and southern Australia, few Stubble Quail were present in the winter, most having left by the end of May. North also stated that on the mainland the timing of the beginning of the shooting season for Quail caused much dissent, because it was intended to take place after the breeding season, but before most Quail had left the area. If conditions were favourable, the breeding season of Quail might last until as late as April and it was possible that Quail were still breeding when the shooting season began. North (citing G.A. Keartland) stated that in Victoria, for example, in 1911 the Quail shooting season started on 15 February. North (1913, p. 171) reported that in inland areas of NSW around Moree and Narrabri, sportsmen were taking huge bags of Quail from mid April until the season closed in mid September, indicating that the Stubble Quail were wintering in inland areas.

In Tasmania, Littler (1910, p. 106) described the Stubble Quail as a 'fine game bird', which 'from the first settlement of the State always afforded considerable amusement to the sportsmen'. He also stated that the shooting season began on 1 May and ended on 30 June. He did, however, express some concern for quail populations, owing to excessive hunting, saying:

> Some few years since an effort was made by a number of sportsmen to have Quail in general totally protected for at least a couple of seasons, for it was argued that the birds were becoming woefully scarce. Nothing came of the agitation...

Later, the *Tasmanian Birds and Animals Protection Act 1919* reduced the season for Stubble Quail shooting to one month: 'The [hunting] season on stubble quail.... was from 1st to 30th June in Tasmania' (Kinghorn 1928, p. 270). No mention was made of a season for Brown Quail.

Of the 14 specimens of Stubble Quail held in museums, for which information on the time of year that they were collected is available, five were collected in May and June. This figure is biased, however, by the fact that three specimens were collected in May 1909 by Littler (see Appendix 1). The fact that the Quail was a

popular gamebird in Tasmania, with such a late shooting season, suggests that significant numbers of birds remained in Tasmania after the usual finish of the breeding season, and presumably overwintered in the state.

Did the Stubble Quail become extinct in Tasmania?

It is possible that the Stubble Quail became extinct in Tasmania, and that those individuals now occasionally seen are stragglers from either the Australian mainland or King Island. Although the *Coturnix* quails are ground birds that are generally seen to fly only when flushed by an observer, they are capable of long-distance movements. The Common Quail of Europe and Asia is generally migratory (Cramp 1980), and the Stubble Quail of mainland Australia is considered nomadic, being reputed to move long distances in search of suitable habitat conditions (Reader's Digest 1976). One Stubble Quail banded in the South Australian wheat belt was recovered after having moved 1143 km in 3 months (Frith & Waterman 1977). No bird banded in Frith & Waterman's (1977) study that travelled >100 km was recovered <2 months after banding. However, since all of these birds were recovered in Victoria, the date of recovery was limited by the start of the Victorian shooting season.

Sightings of Stubble Quail in Tasmania, recorded in the *Tasmanian Bird Report*, have generally been in the north-west, on Hunter and Robbins Islands (Patterson 1983, 1988) and at Woolnorth (Anon. 1977; Patterson & Rounsevell 1984). The only exception is a sighting at the Henty River (Patterson 1984) in the west near Queenstown. Therefore, all but one of the sightings of Stubble Quail, reported (in the *Tasmanian Bird Report*) before the establishment of the persistent population at Cressy, were on offshore islands or in mainland Tasmania closest to the landfall of birds flying from King Island. The evidence does suggest that, after the decline of this species in Tasmania, the only individuals to be sighted, except on King Island, may have been stragglers.

Reader's Digest (1988), after accepting that the Stubble Quail had once been abundant in Tasmania, then declared it to be extinct. Marchant & Higgins (1993) stated that all recent Tasmanian mainland records have occurred between September and March. Although this timing suggests movement into and out of Tasmania, the small numbers present may be easier to detect during the breeding season. Sharland (1958, p. 5) suggested that 'there is some hope of this quail's restoration, for it is a migrant, and therefore numbers may come across from the mainland and eventually re-establish the species...'

Miller (1938, p. 288), on Stubble (and Brown) Quail in Victoria, suggested that:

> the possibility of a southern movement (to Tasmania and the Bass Strait Islands) or eastern (to eastern Victoria and New South Wales), should be considered. In support of either or both of these might be instanced the following facts: Numbers of observers have noticed on certain of the Bass Straits islands that one day there will be no Stubble Quail, and the next thousands so tired that they are unable to fly, and after a day or so again no Quail... It seems to me, therefore, then, as far as the Gippsland Quail are concerned, it is southwards or remain... A note by P.L.C. O'Shannassey from San Remo on May 5, 1903, and published in the *Emu*, vol. III,

> p. 121, states: 'I noticed some time ago in one of the daily papers a reference to Quail having been washed ashore in numbers on the south-east coast and in Western Port. I have made the most searching inquiry, and fail to find anyone who can throw any light on the subject locally.'... The writer [O'Shannassey] then casts doubt on the reference. Such reports are, however, not to be lightly thrust aside, since undoubtedly accurate reports of similar occurrences are common with the European Quail. This would certainly suggest movement to and from Tasmania and the Islands.

Were Tasmanian Stubble Quail a genetically distinct population?

The possibility that Stubble Quail in Tasmania have been sufficiently isolated from mainland populations to have become genetically distinct might be precluded by the possibility of movement across Bass Strait, and may also depend on both the size of the original Tasmanian population and the extent of immigration. Certainly in the *c.* 60 years since the decline in Stubble Quail was first noted, the extent of movement across Bass Strait has not been sufficient to justify Sharland's (1958) hope that its population might be restored through immigration. If Stubble Quail have become extinct in Tasmania, then the level of immigration has only been sufficient to produce a few sightings and perhaps a small resident population near Cressy.

The currently accepted position is that there are no recognised subspecies of Stubble Quail. However, the Stubble Quail is most closely related to the New Zealand Quail, which became extinct in the 1870s (Gill 1991), and closely related to the Common Quail, and the Japanese Quail *Coturnix japonica* (or sometimes *C. coturnix japonica*). Some authorities have suggested that the latter two species form a superspecies (Cramp 1980) or a species-complex to which the Stubble Quail is also closely allied (Marchant & Higgins 1993). John Gould originally described the Stubble Quail as a separate species from the New Zealand Quail, but from the late 1970s to the early 1990s the two were commonly considered conspecific (e.g. Thomas 1979; Blakers *et al.* 1984; Beruldsen 2003). This view has been discredited recently (Seabrook-Davison *et al.* 2009).

Within this putative '*Coturnix coturnix* complex', different species may have very different life histories, especially with respect to dispersal behaviour. Included within what are considered to be true *C. coturnix* are migratory European forms (Cramp 1980), southern African forms (probably with a nomadic lifestyle similar to the Stubble Quail) (Clarke 2006), and resident insular forms (Stuart & Stuart 1999). Although closely related, New Zealand Quail and the Stubble Quail on the Australian mainland apparently differed significantly in their life histories. Although there is no information on the movements of New Zealand Quail, Marchant & Higgins (1993) suggested that that species had reduced powers of flight, being larger and having relatively shorter wings than Stubble Quail. It is unlikely that New Zealand Quail undertook long-distance movements. On mainland Australia, however, the Stubble Quail is highly mobile and nomadic (see previous discussion). Although the reason for the extinction of the New Zealand Quail is not completely understood, it is likely that the burning of its grassland habitat to provide green feed for the growing sheep industry played a major role (Buller 1888; Marchant & Higgins 1993). The sedentary/resident lifestyle of the

New Zealand Quail may have made this species more susceptible to the effects of environmental change.

Although some authors have suggested movement of Stubble Quail back and forth between Tasmania and the Australian mainland, there is little direct evidence to support this idea. Several land-bird species migrate across Bass Strait, but Bass Strait has also proved an effective barrier to a number of Tasmanian endemic species and Victorian species (Abbott 1972). Although the observations of Miller (1938; see pp. 32–33) suggest movements around the northern edge of Bass Strait and the Bass Strait islands, they also suggest the danger to the birds of dying without making landfall. More recent studies of Stubble Quail movements suggest that Stubble Quail do not show any regularity in the direction of their movements (Frith & Waterman 1977). The position of the original population of Stubble Quail in Tasmania before the mid 20th century, in relation to the mainland population, may have parallelled that of insular and mainland populations of Common Quail, and perhaps had a life history more like that of New Zealand Quail, being resident breeders with only local nomadic dispersal. The shorter period of isolation may not yet have resulted in a significant divergence in physical form.

The genetic study by Seabrook-Davison *et al.* (2009) suggests that it may be possible to distinguish between preserved Tasmanian and existing mainland specimens of Stubble Quail. If there are genetic differences between the pre-1940 Tasmanian birds and mainland populations, it may be possible to determine whether the small population currently inhabiting northern Tasmania represents a remnant of the earlier population, or a later re-invasion after the original population became extinct.

Causes of the decline of Stubble Quail in Tasmania

At the turn of the 20th century when Stubble Quail were still abundant in Tasmania, early authors described their favoured habitat as grainfields (Gould 1865; Fletcher 1903; Littler 1910). Both Fletcher and Littler expressed concern for the fate of the Stubble Quail, but its sudden decline came as a surprise and contemporary authors had difficulty explaining it. Sharland (1958, p. 5) admitted that 'the cause is not known for certain', but speculated that 'it may be due to a combination of factors, such as modern methods of harvesting, diminution of food, and the wider use of toxic insecticides and artificial manures, and it is possible also that the domestic cat gone wild has been responsible for considerable mortality'. Green (1977, p. 20) also felt that the cause of the decline of the Stubble Quail 'is debatable. Factors such as shooting, predation by feral cats, and a reduction in grain growing have been suggested, all of which seem doubtful when considered individually. It may be a combination of factors'.

Later, Blakers *et al.* (1984, p. 115) suggested that the disappearance of the Stubble Quail from Tasmania 'correlated with a change in agricultural methods to improved pasture' and (following Green 1977) further suggested that 'Because the bird was sedentary in Tas. ... it may have been more vulnerable to changing conditions'. Although there is no direct evidence of the correlation between pasture improvement and Quail decline, L. Gilfedder (pers. comm.) has indicated

that the timing of the decline (the 1940s) appears to follow the beginning of the establishment of improved pasture (*c.* 1938).

An understanding of the causes of the Stubble Quail's decline in Tasmania probably rests on an understanding of its habitat requirements. Although the way that Stubble Quail habitat has been affected by European agriculture is complex, ultimately it may have been responsible for the decline of this species in Tasmania through habitat degradation.

Olsen *et al.* (1993, p. 123) stated that the Stubble Quail occurs 'in a range of native habitats that include grassy plains and other types of open country', which would have provided its main habitat before European settlement. They stated, however, that 'it has adapted very well to agricultural activities and is now very common in pasture, cropland and stubble'. They contend that the 'wheat-growing areas of Australia probably *now* constitute the stronghold of the species, crops providing shelter and much food in the form of fallen grain' (Olsen *et al.* 1993, p. 123; emphasis added). QPWS (undated) stated that this species is found in open grasslands (improved and natural) and Downs country, cereal crops, stubbles, lucerne, weedy margins of irrigation areas and fallow paddocks.

Olsen *et al.* (1993, p. 123) stated that for the Stubble Quail 'some degree of cover seems to be necessary, so it tends to shun areas that are too closely grazed'. Marchant & Higgins (1993, p. 391) also stated that 'few Quail [are found] in country heavily grazed by introduced stock or by kangaroos... intensively cultivated and grazed land [is] unsuitable [for quail]'.

Although grassy open woodland may provide the ground-cover required by Stubble Quail, it appears that the species does not occupy areas with more than occasional trees. Marchant & Higgins (1993, p. 391) stated that 'Trees may or [may] not be present, but canopy must be open enough to allow development of ground vegetation; ... [They are] Uncommon in small patches of grass within woodland; probably [because they are] reluctant to pass through intervening unsuitable habitat'.

The most important natural habitat of the Stubble Quail in Australia would be what Carter *et al.* (2003) described as lowland temperate grassland, occurring <1000 m above sea-level (asl) in south-eastern mainland Australia and <600 m asl in Tasmania. Most large patches of natural temperate grassland that still exist are on private land (Carter *et al.* 2003). Tussock-forming species from the genera *Austrodanthonia*, *Austrostipa*, *Bothriochloa*, *Chloris*, *Enteropogon*, *Lomandra*, *Poa* or *Themeda* dominate this grassland, and this structural component provides the important habitat component of cover for Stubble Quail. Lowland temperate grassland contains few or no trees, and it is principally this characteristic that distinguishes it from grassy woodlands (Kirkpatrick *et al.* 1999).

In Tasmania, native tussock grassland occurred on many of the fertile plains between Launceston and Hobart. However, lowland tussock grasslands have been heavily cleared, and today only small patches remain on public land, although 'Larger areas of lowland native pastures are still found on grazing properties' (Kirkpatrick *et al.* 1999, p. 2). Thus, the main cause of the decline of natural

temperate grasslands has been the alienation of these areas for agricultural use and their subsequent conversion to artificially fertilised introduced pasture for sheep grazing (Males 2012).

The two main types of lowland grassland (Lowland Silver Tussock Grassland and Kangaroo Grass Tussock Grassland) are both considered endangered in Tasmania (Kirkpatrick *et al.* 1999). The former, generally found on alluvial river flats <600 m asl, where the dominant grass (Silver Tussock *Poa labillardieri*) forms dense tussocks ≤1 m in height, is considered to be the Tasmanian vegetation type that has 'undergone the most destruction since European settlement' (Kirkpatrick *et al.* 1999, p. 2). The latter, dominated by Kangaroo Grass *Themeda triandra,* is found on both well-drained, fertile valley floors in low-rainfall, low-altitude areas, and on shallow soils on well-drained hill tops and ridges on basalt, dolerite and deep sands (Kirkpatrick *et al.* 1999). A similar decline in the extent of natural grasslands has also been experienced throughout south-eastern Australia (Kirkpatrick *et al.* 1999; Carter *et al.* 2003).

At the time of European settlement, natural grasslands were found in the northern Midlands, eastern and central Tasmania (Kirkpatrick 1999) and had an extent of ~850 km². Grasslands were almost totally absent from the west, north-west and north-east (Kirkpatrick 1999). Although the natural habitat of Stubble Quail was the same areas first utilised for agriculture, the initial changes wrought may have favoured the Quail.

Sheep production in Tasmania became the dominant form of agriculture by about the 1820s. By 1900, the number of sheep in Tasmania was ~1.7 million, occupying much of the dry Midlands (Davies 1965). Initially, it is likely that while sheep grazing remained low-intensity on natural grasslands and native pastures, the decline in tree cover associated with the conversion of grassy woodland to pasture would have increased the area of suitable Stubble Quail habitat. Before European settlement, grassy woodland was of much greater extent than native grassland, covering ~4000 km² (Kirkpatrick 1999). Lowland grasslands in the Midlands were commonly bordered by Black Gum (Swamp Gum) *Eucalyptus ovata* woodland, and have been reduced to a few remnants, and grassy woodlands in general have been reduced by 90% by clearing for agriculture (Kirkpatrick 1999).

In the early days of European settlement, the only crop in Tasmania to emerge with an assured market in Sydney was wheat: the land in Tasmania favoured higher yields and higher-quality grain than in the other colonies (Davies 1965). By 1850, wheat-growing had contracted to the more suitable soils, but production still exceeded the combined outputs of NSW and Port Phillip, and the area under cultivation was 64 650 acres (26 180 ha) (Davies 1965). This initial reliance on cereal-growing, and wheat in particular, would have favoured Stubble Quail, and it is reasonable to conclude that Stubble Quail populations probably increased in the early 19th century. In the second half of the 19th century, wheat remained Tasmania's staple crop. The clearing of land for wheat production resulted in Fletcher (1903) reporting that at the start of the 20th century Stubble Quail were common in the wheatfields around Wilmot in the north-west, where previously

they would have been absent. Wheat cultivation, however, steadily depleted the soils and at the beginning of the 20th century cheap produce from the mainland also caused the decline of cereal-growing in Tasmania. By *c.* 1960, wheat-growing had declined to the extent that only 17 560 acres (7110 ha) were under cultivation (Davies 1965).

As cereal production declined through the depression of the 1930s, sheep farming became more intensive. By 1964, the total sheep population of the state had reached 3.6 million (Davies 1965). During dry periods, the greater numbers of sheep in Tasmania would have removed much of the cover and food required by Stubble Quail.

Conclusions

That Stubble Quail continue to thrive on the Australian mainland may be a reason that a dramatic decline in their abundance in Tasmania has been overlooked. This oversight is understandable, given the sparseness of the information on Stubble Quail in the ornithological literature. The literature that does exist, however, is both detailed and credible. The fact that the decline of Stubble Quail has been overlooked by the Tasmanian fauna authorities has precluded consideration of its conservation significance. The demonstration that this decline was real, and not owing to early confusion between Stubble and Brown Quail, must prompt a re-evaluation of the conservation status of the Stubble Quail in Tasmania.

There can be little doubt from the physical evidence that Stubble Quail were formerly much more common in Tasmania than at present. Stubble Quail have declined markedly in Tasmania, partly because their natural habitat has been all but eliminated, as it has been throughout south-eastern Australia. It is also likely that extensive wheat cultivation and low-intensity grazing on natural pastures, combined with the decline in tree cover associated with the conversion of forest and woodland to pasture, would have initially favoured this species. As wheat cultivation declined and sheep densities increased, however, quail habitat would have been degraded through loss of cover. This situation contrasts with the species' habitat on the Australian mainland, where wheat-growing areas now provide the major habitat.

In the absence of systematic surveys, which would be highly desirable, the most objective assessment of the abundance and distribution of the Stubble Quail is contained in the RAOU/Birds Australia atlases. Even within the 19 years between the two atlases, a significant decline has been demonstrated. The Stubble Quail appears to have disappeared from King Island, its former Tasmanian stronghold, and may now be confined to one small resident population centred around Cressy. Based on the criteria used by the Tasmanian Scientific Advisory Committee (SAC 2008) to assess the status of threatened species in that state, the small size of the occupied area (certainly <500 km^2 and perhaps as little as 10 km^2, excluding occasional stragglers), and its presumed small population size (unknown but probably <2500 individuals and perhaps much lower), the Stubble Quail could be provisionally assessed to be endangered, and may be prone to extinction in Tasmania within the next 10 years.

The conservation significance of the decline of the Stubble Quail in Tasmania, when considered in a national context, depends partly on the degree to which the Tasmanian population is genetically distinct from mainland populations. Although the Wedge-tailed Eagle is still common on the mainland, the endemic Tasmanian subspecies (*Aquila audax fleayi*) is listed as endangered by both the Tasmanian and Australian Governments. Current evidence suggests that there are no recognised subspecies of Stubble Quail. At this stage, it is impossible to fully assess this aspect of the conservation importance of the decline of the Stubble Quail in Tasmania. Suggestions that both the pre-1940 population and the small population existing at Cressy are 'sedentary', rather than nomadic, are the only indications at present that the Tasmanian population may be a genetically distinct population.

Recent techniques could be used to determine whether Tasmanian Stubble Quail collected before the 1940s, or the small 'remnant' population found in the north of the state today, are representatives of the same genetic population as mainland birds. It may then be possible to determine whether the small population currently inhabiting northern Tasmania represents a remnant of the earlier population, or a later re-invasion after the original population became extinct.

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Appendix 1. The Tasmanian Stubble Quail specimens held in museums. AM = Australian Museum; ANSP = Academy of Natural Sciences, Philadelphia, USA; ANWC = Australian National Wildlife Collection (CSIRO, Canberra); MV = Museum Victoria; NHM = Natural History Museum (UK) [formerly British Museum (Natural History)]; QVM = Queen Victoria Museum (Launceston, Tas.); SAM = South Australian Museum; and TMAG = Tasmanian Museum and Art Gallery. Specimen type: F = female, M = male; E = egg(s), S = skin. Collection location: FI = Flinders Island, T = Tasmania, V = valley. – = no data. Sources: Walter Boles (WB), Kathryn Medlock (KM), Robert Prŷs-Jones (RP-J), Craig Reid (CR) and Nate Rice (NR), plus ANSP (2013), OZCAM (2013) and Museum Victoria (2013).

Registration no.	*Specimen type*	*Museum*	*Collection location*	*Collector*	*Date*	*Source*
BMNH 1838.1.15.175	M S	NHM	T	R.C. Gunn	1838	RP-J
12306	M	ANSP	T	[Gould specimen]	[Probably 1838–9]	ANSP, NR
12309	F	ANSP	T	[Gould specimen]	[Probably 1838–9]	ANSP, NR
BMNH 1842.12.16.123	F S	NHM	T	[Voyage of HMS *Erebus* & *Terror*]	1840	RP-J
B17657	F S	MV	Cullenswood, T	–	15 June 1874	OZCAM
108500	–	ANSP	Near Hobart, T	Missionary	1885	ANSP, NR
B1416a	–	TMAG	Bagdad, T	G. Sinnett	1894	OZCAM
B1782	–	TMAG	Moonah, T	M.W. Harrison	1895	OZCAM
B7817	F S	SAM	Chudleigh, T	E. Dickenson	8 Jan. 1904	OZCAM
O.50392	E	AM	Sandford, T	W. Richardson	18 Dec. 1905	OZCAM, WB
O.34251	E	AM	Glenorchy, T	W. Richardson	25 Nov. 1906	OZCAM, WB
O.50393	E	AM	Glenorchy, T	W. Atkins	25 Nov. 1906	OZCAM, WB
O.25154	E	AM	Glenorchy, T	M. Harrison	4 Jan. 1907	OZCAM, WB
B25890	M S	MV	Derwent V, T	–	10 May 1907	OZCAM
B1783	–	TMAG	Glenorchy, T	M.W. Harrison	1908	OZCAM
O.50394	E	AM	Glenorchy, T	W. Atkins	15 Dec. 1908	OZCAM, WB
B4629	M S	SAM	Westbury, T	F.M. Littler	3 May 1909	OZCAM
B4630	M S	SAM	Westbury, T	F.M. Littler	3 May 1909	OZCAM
B4631	F S	SAM	Westbury, T	F.M. Littler	3 May 1909	OZCAM
QVM:1985:2:0465	E	QVM	Cleveland T	–	12 Nov. 1930	CR
B3054	–	TMAG	Clarence, T	J. Cruise	1965	OZCAM
B3056	–	TMAG	Clarence, T	J. Cruise	1965	OZCAM
EO6530	E	ANWC	South-east FI	–	15 Nov. 1966	OZCAM

Appendix 1 continued

Registration no.	*Specimen type*	*Museum*	*Collection location*	*Collector*	*Date*	*Source*
QVM:1966:2:0166	F	QVM	Lackrana, FI	–	16 Nov. 1966	OZCAM, CR
B6445	S	MV	T	–	–	MV
B1417	–	TMAG	–	–	–	OZCAM, KM
B1418	–	TMAG	–	–	–	OZCAM, KM
B1419	–	TMAG	–	–	–	OZCAM, KM
B1420	–	TMAG	–	–	–	OZCAM, KM
B2129	–	TMAG	–	–	–	OZCAM, KM
QVM:2006:2:0035	–	QVM	–	–	–	CR
QVM:1958:2:0066	–	QVM	–	–	–	CR
QVM:1958:2:0067	–	QVM	–	–	–	CR
QVM:1958:2:0068	–	QVM	–	–	–	CR
QVM:1958:2:0069	–	QVM	–	–	–	CR
QVM:1958:2:0070	–	QVM	–	–	–	CR

Note added in proof: As the decline of the New Zealand Quail happened soon after European settlement and preceded the spread of exotic carnivores, Abbott (2012) has suggested, on the basis of evidence that he reviewed, that avian disease(s) introduced with poultry may have been a factor in that case. ■